Space Weather Technical Forecast

Issued on Wednesday, 08 March 2023 at 12:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares (R1-R2/Minor-Moderate radio blackouts) likely throughout. Slight chance of G1/Minor Storm intervals 08-09 March. Electron fluence is expected to be Active.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate through the past 24 hours with an M1.8 flare at 08/1009 UTC from AR3242. There are eleven sunspot regions on the visible disc, with the most dominant region AR3242 (Dsi/Beta-Delta) in north centre disc. This has a small delta spot configuration in the centre of the group, though this penumbra may be splitting into two. AR3245 (Dkc/Beta) in the southeast quadrant is the other main spot region, this region may have grown a little but hasn't produced any noteworthy flares sins aa C2.6 at 07/1749UTC.The remaining regions are all relatively simple or evolving slowly.
No Earth directed CMEs were observed in available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR and ACE at L1, has been indicative of a waning High Speed Stream (HSS) from CH81. Wind speeds were at elevated levels early in the period, near 570 km/s, but gradually reduced, and are now around 450km/s. Density has been around average throughout. Total IMF, Bt, was weak below 6nT, with the north-south component, Bz, varying weakly between +/-4nT. Phi angle was primarily negative (towards the Sun). Geomagnetic activity was Quiet (Kp 1 to 2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at background levels. Electron flux at GOES16 has been mostly high with a peak of 2820pfu at 07/1500 UTC. Electron fluence has been above the Active threshold (1e8 integrated flux) throughout, with a value of 1.54e8 integrated pfu recorded at 08/0001 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be mainly Low to Moderate, with a slight chance of Strong activity. The main risk of flares is from AR3242 and AR3245.

Solar Wind / Geomagnetic Activity: There is one possible glancing CME currently forecast on 08 March, but with low confidence. Earth is experiencing slightly-elevated solar wind speeds, still under the waning influence of a HSS from the large coronal hole 81 which is now near the western limb. The HSS is expected to continue to wane through Day 1 (08 Mar), but enhanced winds are likely to be prolonged by the smaller coronal hole 82 which could connect later on Day 1 or on 2 (08-09 Mar). As the Earth is approaching the vernal equinox, negative polarity coronal holes such as 81 and 82 are favoured for providing a slightly stronger geomagnetic response. Geomagnetic activity is expected to be Quiet to Unsettled throughout the period, with a slight chance of Active or G1/Minor Storm intervals on Days 1 and 2, mainly due to any glancing CME effects or the onset of coronal hole 82.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels but with a slight chance of reaching S1 or greater should any larger flares occur. Electron flux is likely to continue at high levels but with uncertainty due to the risk of a CME glancing blow and a further HSS potentially suppressing levels. Electron fluence is above the Active (1e8 integrated pfu) threshold and is likely to remain so through the period, albeit with some uncertainty.

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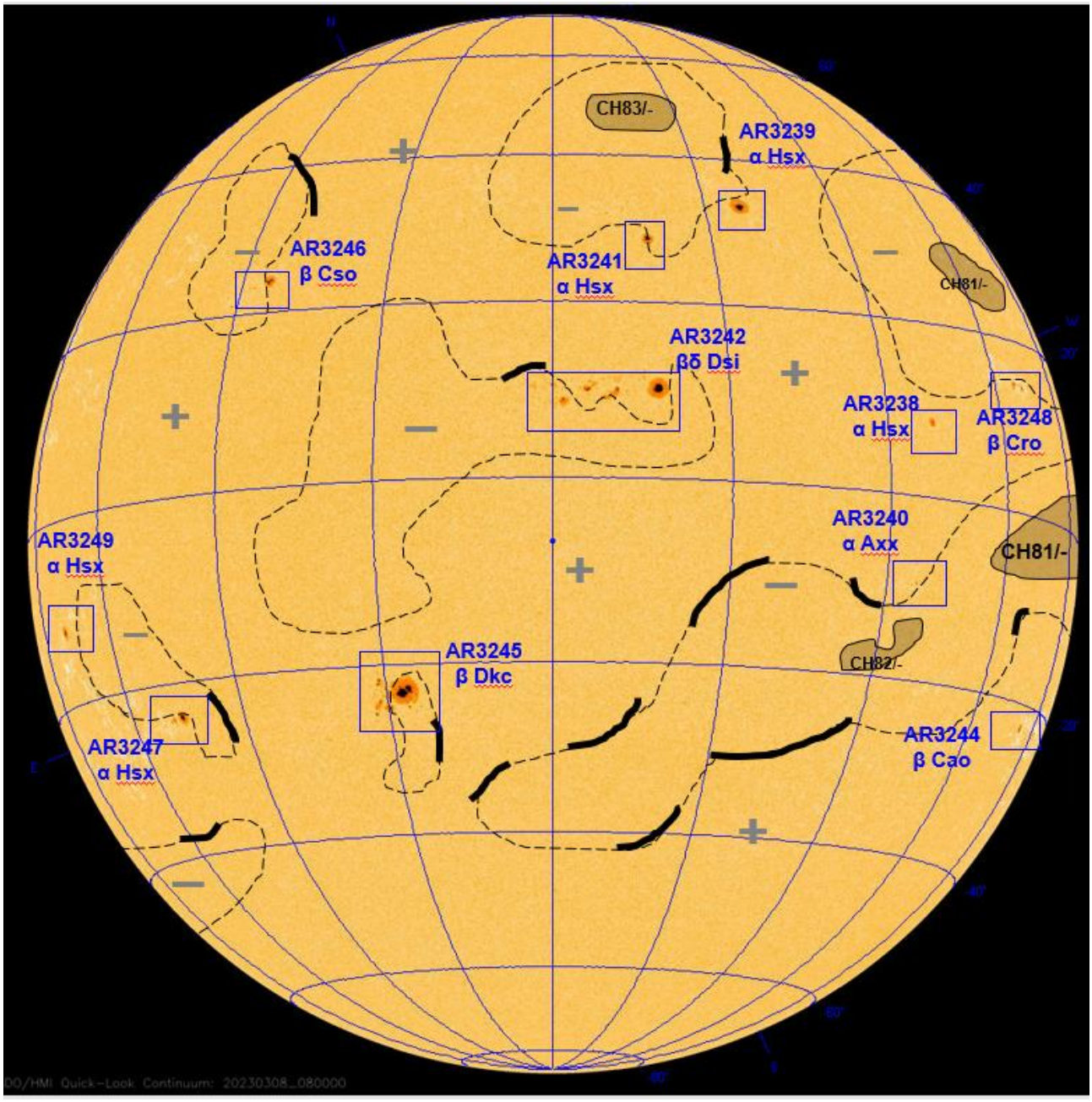
Figure 1. Solar Analysis Valid 08/0800 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one possible glancing CME currently forecast, but with low confidence. This was a CME which left the Sun on 05 Mar, which could just glance the Earth on 08 Mar, however it is more likely to miss ahead of the Earth orbit.

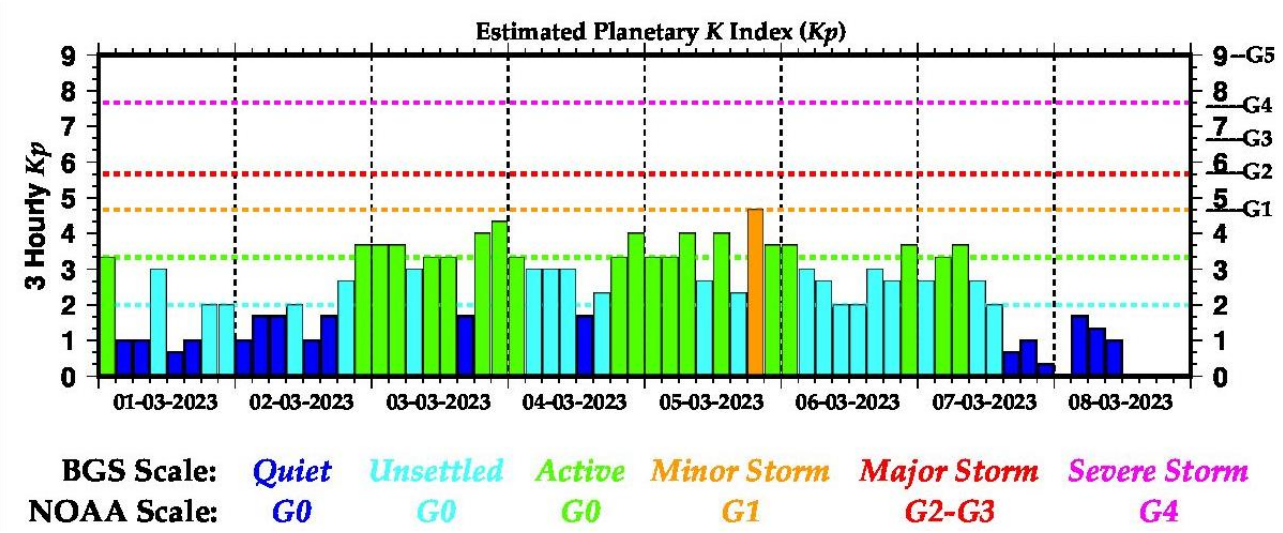
Earth is experiencing elevated solar wind speeds, still under the waning influence of a HSS from the large coronal hole 81 which is now near the western limb. The HSS is expected to continue to wane through Day 1 (08 Mar), but enhanced winds are likely to be prolonged by the smaller coronal hole 82 which could connect later on Day 1 or on 2 (08-09 Mar). As the Earth is approaching the March equinox, negative polarity coronal holes such as 81 and 82 are favoured for providing a slightly stronger geomagnetic response.

Geomagnetic activity is expected to be Quiet to Unsettled throughout the period, with a slight chance of Active or G1/Minor Storm intervals on Days 1 and 2, mainly due to any glancing CME effects or the onset of coronal hole 82.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections- Nil

Figure 2: Estimated Planetary Kp from BGS



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Radio Blackouts - X-Ray Flares:

Solar activity has been Low through the last 24 hours with occasional C-class flares from AR3243, 3245, and 3242.The largest a C4.7 flare at 07/0405UTC from 3243.
There are twelve sunspot regions on the visible disc, with the most dominant region AR3242 in north centre disc. This has a small delta spot configuration in the centre of the group, although activity of late has been limited. AR3245 in the southeast quadrant is the other main spot region, but has shown some fragmentation in its rear portion, with the previous delta configuration no longer evident. AR3243 is transiting the northwest limb so will have a rapidly reducing contribution to the flare probabilities. The remaining regions are all relatively simple or evolving slowly. However, any loss off the west limb is likely to be balanced by further possible returning regions rotating onto the east limb, with risks kept stable through the period.
Solar activity is forecast to be Low to Moderate, with a slight chance of isolated X-class flares throughout.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. As AR3242 begins to transit the western hemisphere it poses an increasing risk of radiation storms should it produce any larger flares. AR3245 will also make a small contribution despite its southeast location. Overall, the probabilities have been kept flat through the period with AR3242 and AR3245 forming the bulk of the risk.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	15	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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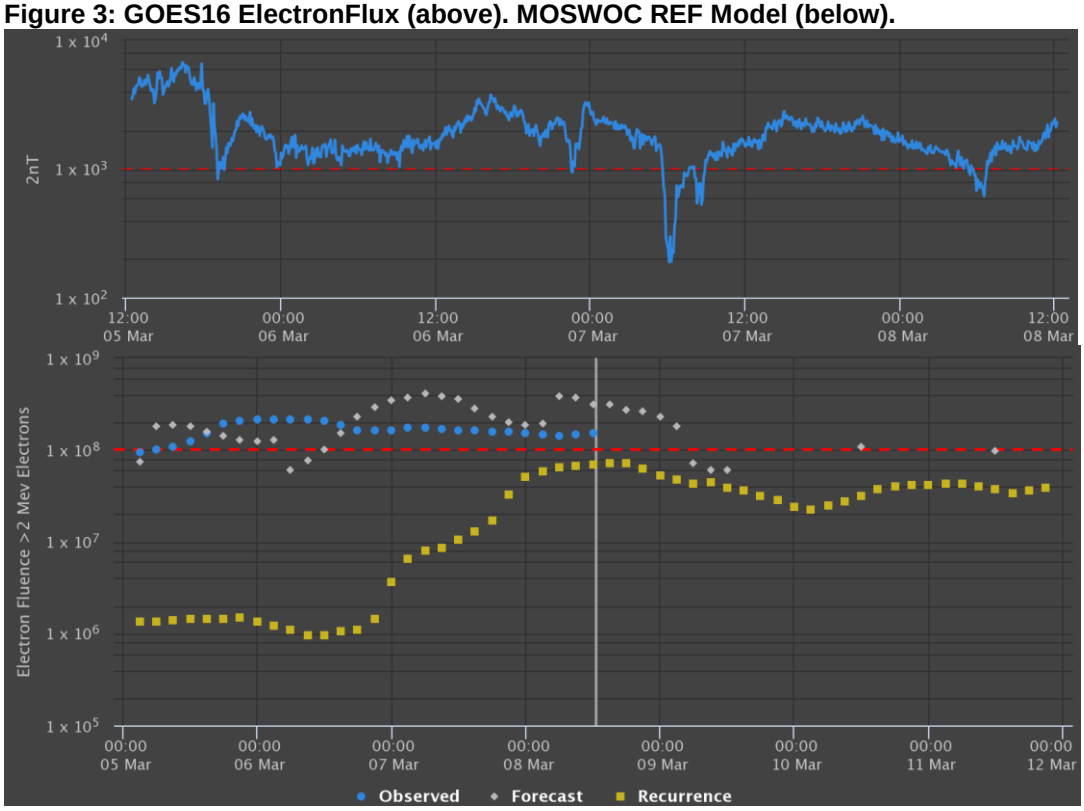
High Energy Electrons Event (≥ 2MeV):
Electron flux is at mostly high levels due to recent inputs from the coronal hole high speed stream. This is likely to remain above the high threshold through much of the period. However, any geomagnetic activity from a potential CME glancing blow or the onset of CH82 could reduce electron flux levels, but these are a low likelihood. There is also a risk of an increase in electron flux as the radiation belt is currently thought to be more significantly charged below GEO. As the high speed stream from coronal hole 81 eases and the radiation belt relaxes and expands, the electron populations at lower orbits could enhance the GEO electron counts, although the potential connection of coronal hole 82 on Days 1 or 2 (08-09 Mar) could inhibit this relaxation. Electron fluence is expected to remain above the Active (1e8 integrated pfu) threshold, with a very slight risk of exceeding the Very Active threshold, although with a possible slow downward trend later in the period. MOSWOC REFM is forecasting an above Active trend through the coming three days, which seems reasonable.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	90	80	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	5	5

Figure 3: GOES16 ElectronFlux (above). MOSWOC REF Model (below).



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